

# **DART Alt. Fuels Program, 2003 Status Update**

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*Presented to:*

**“Natural Gas Vehicle  
Technology Forum”  
Dallas, TX.**

**Wed., January 29, 2003**

**Dallas Area Rapid  
Transit**



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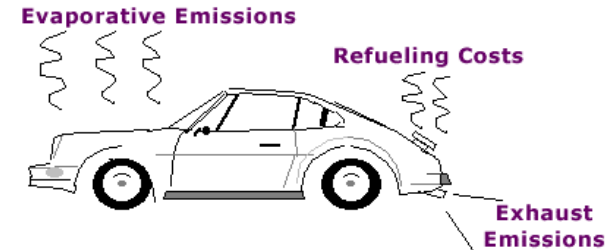


# DART Alt. Fuels Program Overview (slide #: 2)

## Presentation Order

- ◆ **DART Alt. Fuel Vehicle Fleet Program Snapshot**
- ◆ **Start-up Experiences w/ New Technology**

# DART Clean Fuel Fleet Initiatives



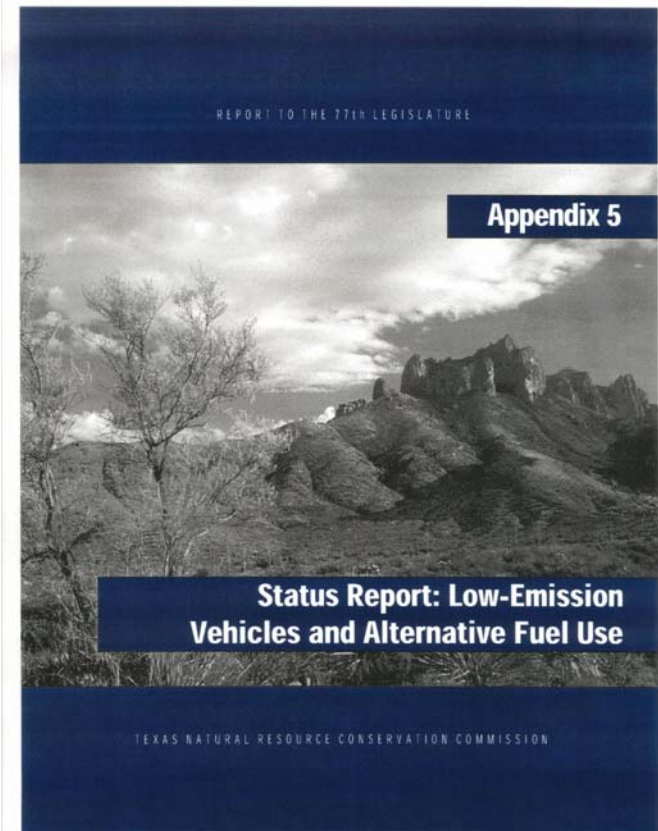
## Board policy adopted in early 1996 requires DART:

- “...take all reasonable steps and makes use of available technology to limit the amount of environmental pollutants...”
- “...procure and use engines and fuels which produce only low emissions of pollutants.”



# DART Clean Fuel Fleet Initiatives

- ◆ TNRCC reported:
  - DART generated 730 pollution credits in 2000
  - 60% of all credits generated by Texas MTAs
  - 219% more credits than next highest MTA



# DART Alt. Fuels Fleet Program

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## ➤ **DART Alternative Fuel (Natural Gas) Program**

### **| Non-Revenue Vehicles**

- **~60 % of fleet operates on natural gas**
- **Reliability similar to gasoline**
- **Fueling infrastructure supported by commercial stations (20)**

### **| Revenue Vehicles**

- **~26 % (251 of 960) of fleet operates on natural gas  
(LNG-40' Buses, and CNG-<30' Trolley Buses / Paratransit Vans)**
- **LNG Fueling infrastructure supported solely by DART**

**[80% of fleet classified Texas Clean Fuel Fleet]**

# DART Alt. Fuels Fleet Program

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## DART Bus fleet

- 10 = ULEV Trolley Buses (**CNG** – '98 Chance)
- 184 = ULEV 40' Transit Buses (**LNG** – '98/'02 Nova)
- 91 = LEV 30' Buses (Diesel – '01 Champion)
- 92 = 40' Suburban Buses (Diesel – '91 MCIs)
- 405 = 40' Urban Transit Buses (Diesel – '98 thru '02 Nova)
- 19 = 40' Urban Transit Buses (Diesel – '83/'84 GMC-RTS)

**Total: 801**

## DART LRV, Paratransit, & Pool Car (NRV) fleet

- 95 = ZEV LRVs (Electric)
- 142 = ULEV Non-Revenue Vehicles (gasoline(86)/Diesel(56))
- 176 = ULEV Non-Revenue Vehicles (**CNG-dedicated**)
- 29 = ULEV Non-Revenue Vehicles (**CNG-Bi-fuel**)
- 102 = LEV Paratransit vehicles (Diesel)
- 57 = ULEV Paratransit vehicles (**CNG-Bi-fuel**)

**Total: 601**

# DART Alt. Fuels Program Overview

## ➤ DART Alternative Fuel (Natural Gas) Program (slide #: 7)

### | Non-Revenue Vehicles

- **Type & Engine Configuration of DART's NRV Fleet operating on natural gas consists of:**

- Automobile - Compact (Bi-fuel=CNG/Gasoline)
- Automobile - Full-size (Dedicated CNG)
- Pickup - Light Duty (Bi-fuel=CNG/Gasoline)
- SUV - Light Duty (Bi-fuel=CNG/Gasoline)
- Truck – Heavy Duty (Bi-fuel=CNG/Gasoline)
- Van – Medium Duty (Bi-fuel=CNG/Gasoline)
- Van – Medium Duty (Dedicated CNG)

### | Revenue Vehicles

- **Type & Engine Configuration – DART's Revenue fleet operates on natural gas:**

- Bus-Transit – Chance Trolley (Dedicated CNG) – 10 ea.
- Bus-Transit – NovaBUS, Inc. (Dedicated LNG) – 184 ea.

# Annual Fuel Consumption Data, Alt. Fuels Fleets (DART vs. The

## City of Dallas) DART Alternative Fuel (Natural Gas) Fleet vs. The City of Dallas AFV Fleet....FY2002 (avg.)

### ➔ DART Alternative Fuel Vehicles, "Fuel Consumption" (ANNUAL):

<u>Alternative Fuel Type</u>	<u>Amount</u>	<u>Unit of Measure</u>
<b>CNG</b> (Dedicated & Bi-Fuel)	<b>290,000</b>	Gallons/Gas Equivalent(GGE)
<b>LNG</b>	<b>5,160,000</b>	Gallons (LNG)

### ➔ The City of Dallas, Alternative Fuel Vehicles, "Fuel Consumption":

<u>Alternative Fuel Type</u>	<u>Amount</u>	<u>Unit of Measure</u>
<b>CNG</b> (Vehicles w/ Dedicated CNG)	<b>409,300</b>	Gallons/Gasoline-Equivalent(GGE)
<b>CNG</b> (Vehicles w/ Bi-Fuel CNG)	<b>33,000</b>	Gallons/Gasoline-Equivalent(GGE)
<b>Total:</b>	<b>442,300</b>	Gallons/Gasoline-Equivalent(GGE)



# DART Fuel Costs Data (slide #: 9)

## DART Natural Gas and LNG Fuel Costs:

- LNG (via Alt Fuels) = \$0.17 / lb. (\$0.54 / LNG gal.)
- CNG (via Transtar) = \$1.12/gasoline gallon equivalent

**NOTE: *LNG Fuel Quality: 99.66% (avg.) Methane content***  
[...from DART's Independent Lab (CPM Labs, Inc.) test results...]

# DART Alt. Fuels Program, 2003 Status Update

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## DART's LNG Transit Bus Fleet:

➡ 184 active LNG buses (NWES=92 / SOCBOF=92)

### **Revenue service operating stats.:**

➡ 25 . 1 million fleet miles operated, from Mar. 1998 thru Dec., 2002.

➡ 15 . 1 million gallons of LNG fuel used, from Mar. 1998 thru Dec., 2002.

➡ Avg. LNG Fuel Economy: 1 . 7 mpg

➡ Drivers report no difference in performance between LNG and diesel buses.

# Commercial CNG Refueling Stations

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[http://www.afdc.doe.gov/refueling\\_mapsite.shtml](http://www.afdc.doe.gov/refueling_mapsite.shtml)

**20** (approx.)  
- **Compressed Natural Gas (CNG)**  
**Refueling Station(s)**  
**are**  
**commercially**  
**available**  
**within a 25-**  
**Mile Radius**  
**of the Dallas**  
**Metro Area.**

# DART LNG Fueling Facility

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◆ DART Commissioned the LNG Fueling Station at our Northwest location in April, 1998. The NW system consists of two(2) - 30,000 gallon horizontal LNG storage tanks and three (3) each Pumps & Dispensers.

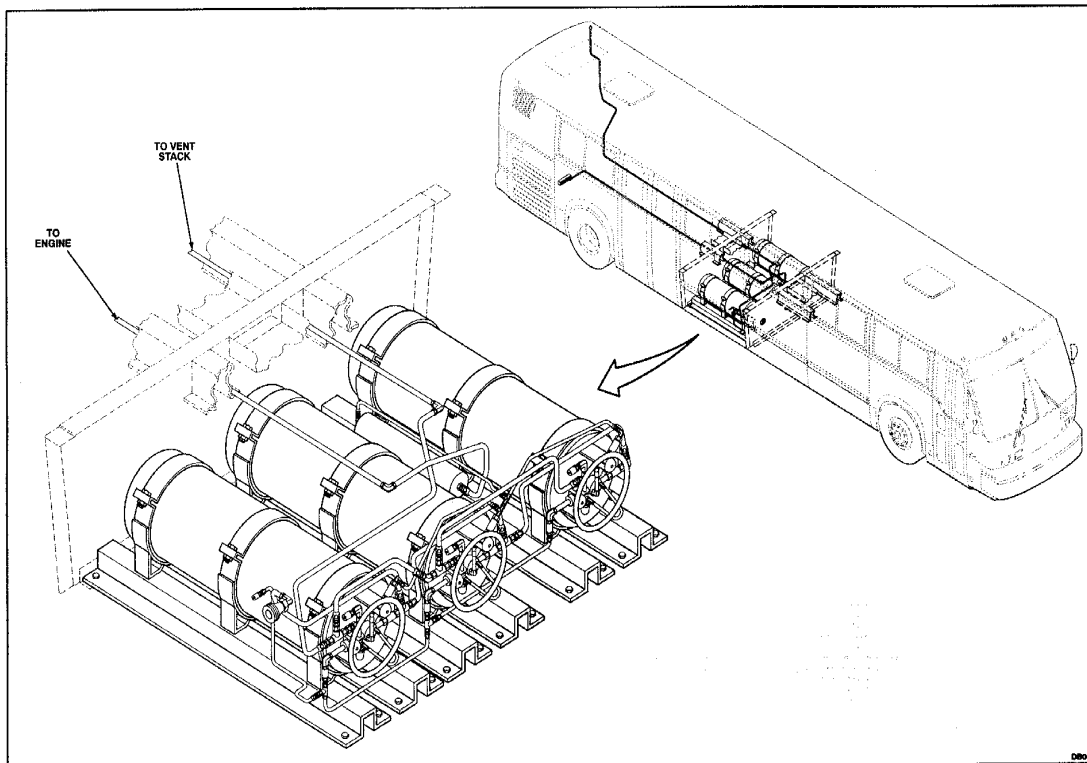
- ◆ New South Oak Cliff Division (SOCBOF) opened in May, 2000 with an additional Pair of horizontal LNG storage tanks of 20,000-gallon capacity each, with three (3) each Pumps & Dispensers.



**(Slide #: 13)**

5 useable).  

5 useable).



# Start-up Experience / New Technology Challenges:

## “1<sup>st</sup> Generation LNG Buses” (Slide #:

14)

- **LNG Range Tests - 3**
- **Altoona Test (LNG Bus Test)**  
**- *Not performed, Waived by FTA***
- **(LNG) Gas Engine Fuel Regulator Test - *Passed (80-100 psig)***
- **Drive away at LNG station, needed break away hose and/or lockout circuit.**
- **LNG Fuel Tank Repairs of economizers & check valves**  
**- *Bench tested and adjusted.***
- **LNG Vaporizer Performance Test - *Passed (4 gpm flowrate-min.)***
- **Out-of-Fuel Road Calls Analysis - *Useful Data***
- **L10G Engine Failures, due to exhaust valves burning, wastegate, ignition coils, & spark plugs. *Cummins campaigned fleet.***
- **Leaky fueling nozzle, some progress in last redesign from JC Carter.**



# Start-up Experience / New Technology Challenges:

## “2<sup>nd</sup> Generation LNG Buses” (Slide #: 15)

The New 2<sup>nd</sup> generation LNG bus on-board LNG fuel system is made up of 3 – 108 gallon individual tanks.

- Total Capacity: 324 gross -- 108 ea. (290 useable LNG gallons).
- Estimated fuel range at this capacity:  $290 \times 1.6 \text{ mpg} = 464 \text{ mile range}^*$ .



# Next Generation - On-board Fuel System Management Panel



## ➤ New Fuel Management Panel

1. Fuel Pressure Gauges (3)
2. Fuel Level Gauges (3)
3. Fuel Fill Lamps (Green LED) (3)
4. Fault Indicator Lamps (Amber LED) (3)
5. Panel Test Switch (Momentary) (1)
6. Manual Fuel “Shut-off” Valve (1)
7. Manual “Vent” Switches (1)
8. Proximity Switch, Engine (1)  
No-Start (*Not Shown*)

## ➤ Requirements & Operation

- A. All gauges to be in 5% tolerance.
- B. Fuel Full Lamp “On” when Fuel Gauge is outside parameters (i.e. below empty or above full)
- C. When Test switch is applied:
  1. All Fuel Level Gauges go to Full and/or Empty.
  2. Fuel Fill & Fault Indicator Lamps go to “On”



Previous Design



# Start-up Experience / New Technology Challenges:

## “2<sup>nd</sup> Generation LNG Buses” (Slide #: 17)

- **Duplicate Design** – Operation & componentry like 1<sup>st</sup> Generation buses. (Door/Receptacle/Gauges)
- **Altoona Test (LNG Bus Test)** - *NOT Waived by FTA; Structural Frame review.*
- **Tanks Ground Clearance / Breakover Angle**
- **LNG Range Test** – Re-test due to Economizer valve setting Chg. & Check Engine Light/DDC code
  - *NOTE: Bus traveled for 438 miles + 1 hr. idle. & 450 miles ttl, to empty.*
- **Out-of-Fuel Road Calls Analysis** – *Closure of "Excess Flow Valve" experienced during 30-day test.*
- **New Electronic Solenoid Valve** – *introduced on Vaporizer out.*
- **DDC Low Fuel Pressure Regulator** - *Loose fitting caused another Roadcall – simulated "Low Power" condition.*

# Lessons Learned... (Slide #: 18)

- ✓ **Design Reviews - review proposed Design Carefully!!!**  
Critical vehicle systems should undergo engineering design validation and/or performance tests before acceptance.  
**Ensure Performance Expectations are met!**
- ✓ **Testing - require and actively participate in engineering design validation tests. § *Theory Guides but, Experiment Decides!* §**
  - ◆ Station commissioning activities. ◆ Altoona Test Report(s) review.
- ✓ **OEM Teamwork - LNG industry (Station Designers (OEMs) and Bus Manufacturers) needs to**

# Lessons Learned-cont. (Slide #:

19)

- ✓ **Attitude Towards Alternative Fuel the use of LNG or any Alternative Fuel will require a change in the Agency's "operational practice & procedures".**
- ✓ **The Fuelers - LNG Bus Interface with Service Personnel (Fuelers). Ergonomics review.**
- ✓ **Dedicate Technical Support (Resident LNG "Expert") in-house!?**
- ✓ **Training - Mandatory**





# DART Alt. Fuels Program, 2003 Status Update

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## End of Presentation

Questions?

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